Special Article

The Epidemiology of Firearm Deaths Among Residents of California

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Firearms are a leading cause of death in the United States, yet the effort to understand their aggregate impact on the public's health has only just begun. There were 26,442 firearm deaths among California residents during the years 1977 through 1983. During this period firearms were the eighth leading cause of death for California as a whole, sixth for male Californians and first for black males aged 15 to 34 years and black females aged 15 to 24 years. A plurality of firearm deaths were suicides; unintentional deaths contributed only 3% of the total. Black men aged 25 to 34 years had the single highest firearm mortality rate; 80% of firearm deaths in that group were homicides. Men 75 years old and older had the highest firearm mortality rate when all races were considered together, however, and 93% of firearm deaths in that group were suicides. The discussion focuses on our current understanding of firearms as a medical and public health problem and suggests directions for future research and intervention.

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Firearms are a leading cause of death and disability in the United States. Each year more than 30,000 Americans die as a result of gunfire. More than 100,000 injuries have been estimated to occur annually from unintentional shootings alone.[1] With few exceptions[2-4] epidemiologic analyses of firearm mortality have considered only one aspect of the problem, separating murders from suicides from unintentional deaths.

This article analyzes the 26,442 firearm deaths that occurred to California residents from 1977 through 1983. It focuses on the vehicle common to these deaths—the gun—in an effort to provide a clearer estimate of the impact of firearms on the public's health. By de-emphasizing the behavioral aspects of firearm deaths, this unifying approach also promotes the consideration of prevention strategies beyond those addressing the behavior of persons actually involved in shootings. It may well be that here, as elsewhere in medicine and public health, the most effective preventive measures do not attempt to modify the behavior of those to be protected.

Methods

Data from death certificates for all deaths occurring to California residents from 1977 through 1983 were obtained by a computerized search of the California Master Mortality File. The 1980 census data for California were used for a mid-interval population; intercensal estimates were obtained from the Population Research Unit, California State Department of Finance.

The study period spanned the transition from the 8th to 9th edition of *The International Classification of Diseases*, but no coding changes affected firearm death ascertainment. The following types of firearm deaths, listed with their *ICD* "E" (external cause) codes, were included in the study: unintentional deaths (E922), suicides (E955.0 to E955.4), homicides (E965.0 to E965.4) and deaths of undetermined intent (E985.0 to E985.4). Firearm deaths by legal intervention (E970) and those resulting from operations of war (E991) were excluded. (The *ICD* rubric for unintentional firearm deaths includes the rare peacetime deaths that occur among military personnel during training.) Delayed firearm deaths were perforce excluded as they are not coded separately from other delayed deaths from external causes. The combined exclusions accounted for less than 5% of firearm deaths.

The leading causes of death for Californians* were reranked, listing firearms separately and excluding firearm deaths from those categories in which they would otherwise be found. Nonfirearm suicides and homicides were combined into a "nonfirearm intentional death" category. Standardized mortality ratios were used as a summary measure of the evenness of distribution of firearm deaths across race and gender groups. Years of potential life lost were calculated using the method employed by the Centers for Disease Control.[5]

Three limitations resulting from this study's reliance on death certificate data should be noted. While diagnostic accuracy for firearm deaths should be high, as virtually all these death certificates were signed by a coroner following an investigation and autopsy, accuracy for nonfirearm causes of death

*The definitions employed were those of the California State Center for Health Statistics, which are virtually identical to those used by the National Center for Health Statistics.

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may be lower.[6] Second, this article does not report separate results for Hispanics. California vital statistics do not categorize Hispanics separately, but classify them as white unless a different racial origin is noted on the death certificate. Finally, separate results for handguns, rifles, shotguns and other firearms are not presented, as the type of firearm involved was reported in only 20% of firearm deaths.

Results

Firearms caused 26,442 deaths among California residents during the years 1977 to 1983—2% of all deaths in that population. The mean annual crude firearm mortality rate was 16.0 per 100,000 population. Rates for individual years ranged from 14.4 per 100,000 population in 1983 to 17.2 per 100,000 population in 1980; no consistent trend was observed.

Males accounted for 84% of firearm deaths, and had a mortality rate of 27.1 per 100,000 population; the rate for all females was 5.1 per 100,000 population. Age- and gender-specific rates are presented in Table 1. A bimodal pattern in risk existed for males. Men 75 years old and older had the highest firearm mortality rate, followed by young adult men aged 25 to 34 years. For women, a single peak in the 25- to 34-year age group occurred. Rates for both boys and girls younger than 15 were substantially lower than those for all other age groups.

TABLE 1.—*Firearm Mortality Rates* by Age and Gender, and Male:Female Rate Ratios by Age for Californians, 1977-1983*

Age in Years	Both	Gender		M:F Rate Ratio
		Male	Female	
<1	0.34	0.37	0.31	1.2
1-4	0.55	0.67	0.42	1.6
5-14	1.69	2.59	0.75	3.5
15-24	22.73	37.73	6.89	5.5
25-34	24.23	40.85	7.29	5.6
35-44	19.26	31.38	7.18	4.4
45-54	16.69	27.02	6.75	4.0
55-64	14.62	24.83	5.41	4.6
65-74	16.00	30.90	4.25	7.3
75 +	17.04	44.65	1.79	24.9

*Rates are per 100,000 population per year.

TABLE 2.—*Firearm Deaths Observed, Firearm Mortality Rates, Male: Female Rate Ratios and Standardized Mortality Ratios, by Race and Gender for Californians, 1977-1983*

	Deaths Observed	Mortality Rate	M:F Rate Ratio	Standardized Mortality Ratio
Total	26,442	16.0	5.3	—
Male	22,155	27.1		—
Female	4,287	5.1		—
White	20,896	16.6	5.2	1.02
Male	17,402	28.1		1.02
Female	3,494	5.4		1.06
Black	4,875	38.3	6.6	2.48
Male	4,206	67.5		2.61
Female	669	10.3		2.05
Asian	297	3.6	4.5	0.22
Male	242	5.9		0.22
Female	55	1.3		0.24
Native American	100	7.1	5.0	0.45
Male	83	12.0		0.46
Female	17	2.4		0.47
Other	274	1.6	4.2	0.11
Male	222	2.5		0.10
Female	52	0.6		0.13

Race- and gender-specific results are presented in Table 2. The mortality rate for blacks was as much as ten times that for some other racial groups. Blacks suffered nearly 2.5 times as many firearm deaths (an excess of 415 deaths each year) as would have been seen if their age-specific firearm mortality rates had equaled those for all Californians combined.

Age- and race-specific rates for males are shown in Figure 1. Black men aged 25 to 34 had a mortality rate of 135 per 100,000 population, more than three times that for the group at next highest risk and more than eight times that for the state as a whole. Rates were highest for blacks in all age groups except those over 75; the finding that the rate for all male Californians combined was highest over age 75 (Table 1) derived from the increased mortality in that age group among whites. Mortality rates for other races tended to be maximal in young adulthood and decline or remain relatively stable thereafter. (Firearm mortality rates for Asian, Native American and "other" boys aged 5 to 14 and for "other" boys under age 5 were all less than 1.0 per 100,000 population. No firearm deaths occurred among Asian or Native American boys under age 5, or among Native American men aged 75 and older.)

Among female Californians, firearm mortality rates were greatest for blacks in all age groups. Black women aged 25 to 34 had the highest female rate observed, 17.4 per 100,000 population. Rates for females of all races were highest for ages 15 to 34 and declined thereafter.

Firearms and the Causes of Violent Death

Firearms were the leading cause of intentional death in the state, accounting for 54% of all suicides and homicides combined. Firearms were used in 59% of all California homicides. Among persons aged 15 to 34, the high-risk group for homicide in California, 65% of these deaths were attributable

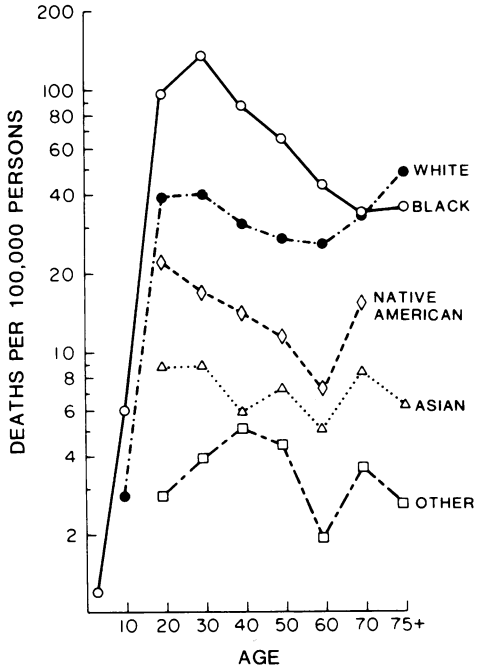

Figure 1.—Firearm mortality rates for male Californians by race and age, 1977-1983

to firearms. Of all suicides, 49% were firearm-related; this percentage remained relatively stable across all age groups.

A plurality of firearm deaths were suicides. Suicides accounted for 12,798 deaths over the study period, or 48% of all firearm deaths. Homicide ranked second with 12,329 deaths, 47% of the total. Unintentional shootings accounted for only 688 deaths, 3% of all firearm deaths. There were 2% classified as undetermined.

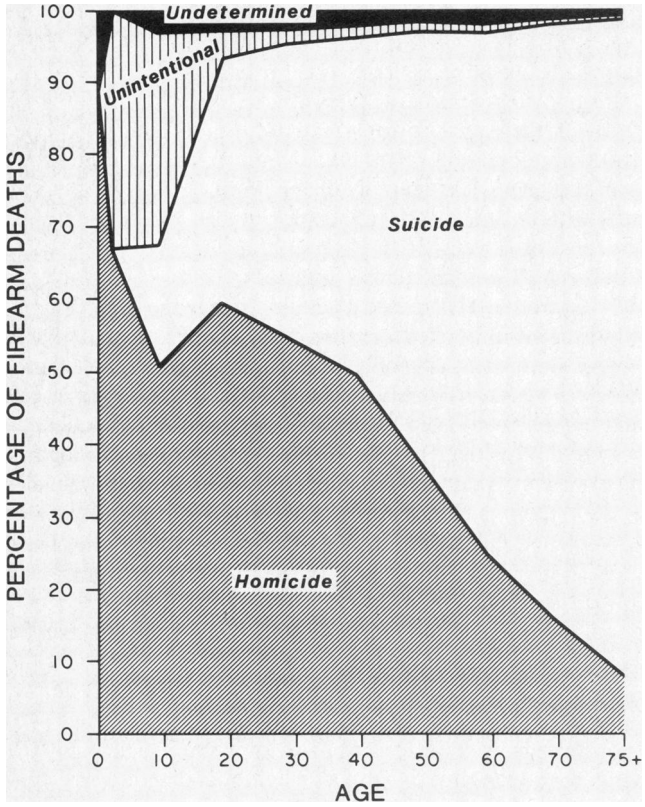

Figure 2.—Percentage distribution of firearm deaths by cause and age for Californians, 1977-1983

The percentage of all firearm deaths attributable to homicide, suicide or unintentional shootings was related to age, as shown in Figure 2. Under age 1, a total of 89% of all firearm deaths were homicides. The percentage contribution of firearm homicide to overall firearm mortality dropped steadily thereafter except during young adulthood. Among persons aged 75 and older, 90% of firearm deaths were suicides. Unintentional firearm deaths were most prominent among children and young adults; 61% of these deaths occurred to persons aged 1 to 24 years.

The distribution of firearm deaths by cause was related to race as well. Among whites, firearm suicides outnumbered homicides by almost 50%; there were 11,863 firearm suicides and 8,041 firearm homicides in this group. For every other racial group, homicides were more frequent. Among blacks there were 3,884 firearm homicides and 702 firearm suicides, a more than fivefold difference.

As a result of these effects, the relative contribution of firearm homicide, suicide and unintentional death varied among the groups at highest risk for a firearm death. For black men aged 25 to 34, a total of 80% of firearm deaths were homicides; only 12% were suicides. Yet for white men that same age, suicides outnumbered homicides and accounted for 48% of all firearm deaths. Among men 75 years old and above, 93% of all firearm deaths were suicides.

Firearms Among Other Causes of Death

Firearms ranked as the eighth leading cause of death for California residents as a whole, sixth for males, second for all persons aged 15 to 34 and first for black males aged 15 to 34 and black females aged 15 to 24. Figure 3 displays the distribution of the major causes of death for persons aged 5 to 54. Firearms accounted for 43% of all deaths among young black men aged 15 to 24 and 19% of deaths in that age group for the state as a whole.

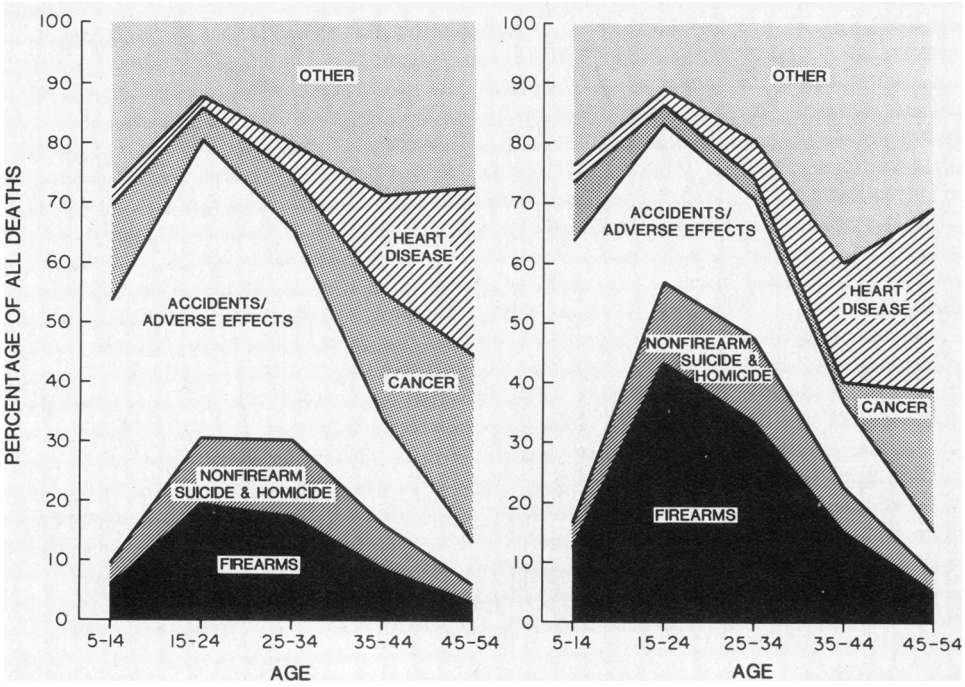

Figure 3.—Percentage of all deaths attributable to each of several leading causes of death. **Left,** Californians, 1977-1983. **Right,** black male Californians, 1977-1983

Firearm deaths among black males resulted in 139,866 years of potential life lost over the study period. By this measure, firearms were the leading cause of premature death for black men and boys. Firearms ranked fourth among causes of premature death for all California residents combined, accounting for 746,705 years of potential life lost. If the firearm mortality rates observed in this study were to remain unchanged indefinitely, 1 in 22 black and 1 in 43 white males born between 1977 and 1983 would suffer a firearm-related death by age 75.

Discussion

The central hypothesis of this study was that examining firearm deaths in aggregate would lead to a clearer picture of the effect of firearms on the public's health. Firearms emerge as a major public health problem. They are the number one cause of death for some segments of the population of California and are among the top ten causes of death for the state as a whole. California is not atypical in this regard; its rates for firearm homicide, suicide and unintentional death are all close to the median for the 50 states.[7]

It was further hypothesized that this approach might yield useful insights into our current efforts to prevent firearm deaths and injuries and suggest directions for the future. This has also occurred.

Suicide was the leading mode of firearm death in this study. It may therefore be inappropriate to rely primarily on criminal justice approaches to firearm deaths and injuries. In fact, such approaches may be inherently limited in their effectiveness against criminal shootings as well. The Federal Bureau of Investigation has underscored this point, stating that "it has long been recognized that murder is primarily a societal problem over which law enforcement has little or no control."[8]

Only 3% of the firearm deaths in this study were unintentional. In 1982 unintentional shootings accounted for only 6% of firearm deaths nationally (National Center for Health Statistics, unpublished data, June 1984). Therefore, it is unlikely that expanded educational efforts to promote the safe use of firearms will lead to significant future reductions in firearm deaths.

There are multiple high-risk groups for a firearm death. These groups differ from one another not only in age, race and gender, but in the types of firearm death for which they are particularly at risk. Prevention strategies targeted specifically at high-risk groups will need to include all these factors.

Such findings support preventive measures directed against firearms themselves. All firearm deaths, however they may otherwise be classified, are by definition associated with a common vehicle of transmission. By analogy, control of many infectious diseases has been dependent upon control of an associated vector. Motor vehicle-related deaths and injuries were substantially reduced by improvements in the design of motor vehicles, rather than efforts to change the behavior of persons using them.[9]

Restricting the availability of firearms, and particularly handguns, is one such measure. In a major study prepared for Congress, the General Accounting Office cited handgun availability as a major determinant of rising firearm homicide rates.[10] A subsequent special study of firearm suicide[11] has yielded supportive results.

Attention to the design of firearms themselves may be beneficial. The Maryland Court of Appeals found in 1985 that a Saturday night special—the highly concealable handgun that was a special target of the Gun Control Act of 1968—constitutes an unreasonably dangerous product. Its manufacturer and distributors may therefore be held liable for harm resulting from its use.[12]

Physicians and other health professionals are uniquely able to bring information on the health effects of firearms to their patients and the public. The dangers inherent in having firearms in the home can be made clear to patients as a part of basic health education. When a major family conflict arises or a patient is seriously depressed, a special effort can be made to ascertain whether there are firearms in the home and to have them removed.

Health professionals can have their greatest effect by initiating communitywide efforts and legislative action. Widespread public support for greater control of firearms has been documented repeatedly.[13,14] The lack of a stable, visible constituency for change has often prevented this support from being translated into public policy.

By emphasizing that firearms are a major public health problem, concerned health professionals can reverse this trend. Through research such as that presented here, they can bring to light the full impact of firearms on health and guide the evolution of public policy in this area. They can promote widespread public awareness at the local level through coalitions with other community leaders. They can educate their local, state and national legislators. They can encourage their state medical societies and similar organizations to become active advocates for measures to minimize the health problem created by firearms. And they can create a new professional association to promote and coordinate all these efforts.

Few health issues in our recent history have engendered as complex and lasting a controversy as that surrounding the prevention of firearm deaths and injuries. Through individual and collective action, health professionals can become a potent force to control this epidemic of modern times.

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